

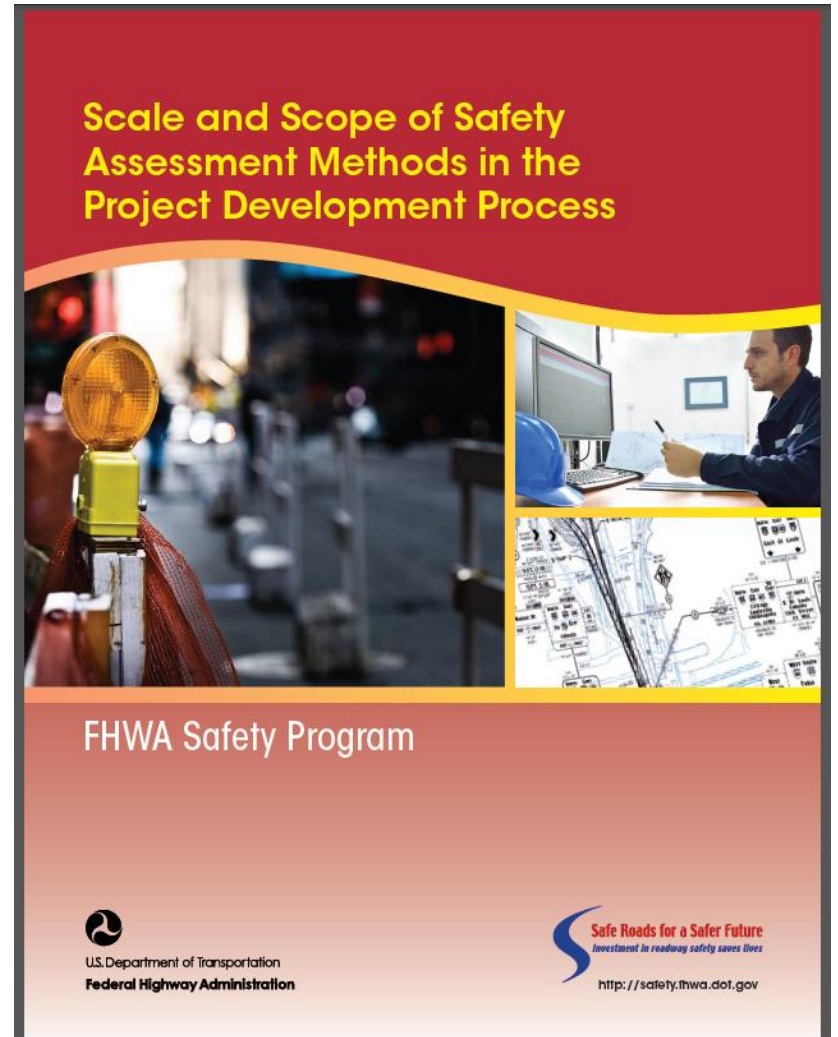
# Network Screening

## *"Into the Darkness"*



# ➤ Safety Assessment Methods

- FHWA-SA-16-016: Guide  
Developed by TPF-5(255) HSM  
Implementation Pooled Fund  
Study
- Observed vs Predicted Methods
- What other states are doing and  
methods they are using
- PA's Network Screening Method



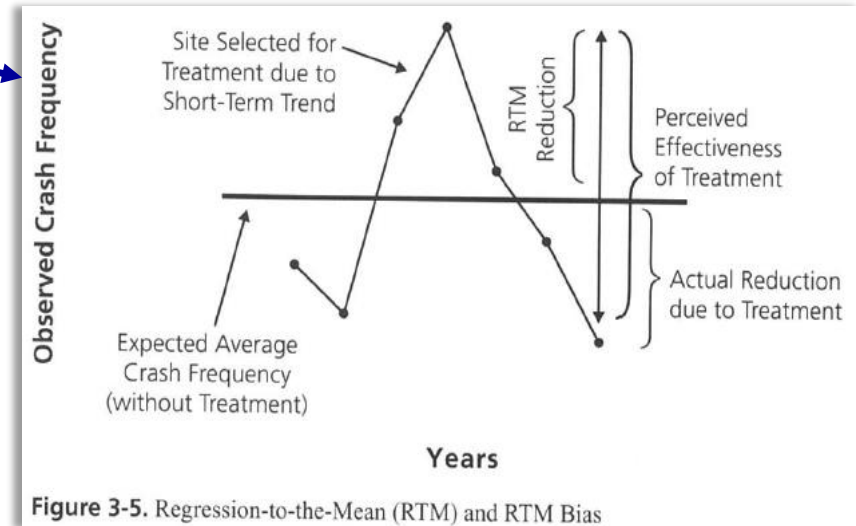
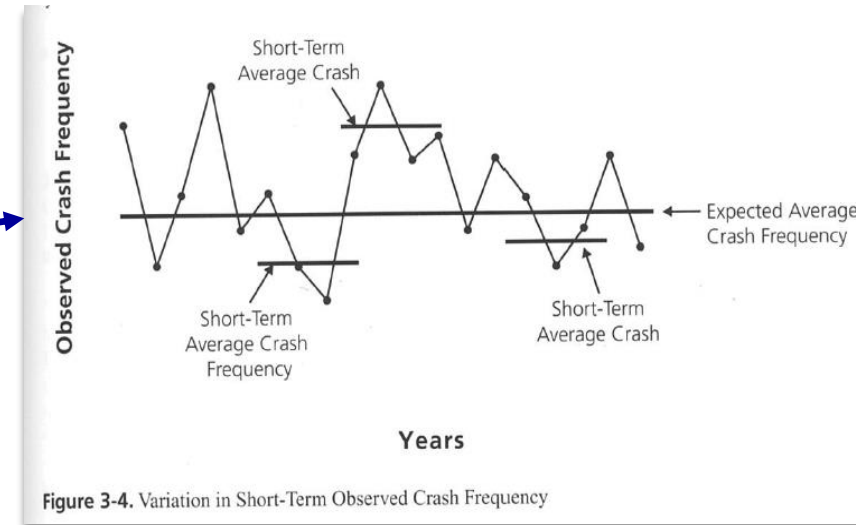
## ► Using Observed Crashes for Analysis

- Can be very relevant & useful in evaluating the recent safety performance on existing facilities
- Becomes less relevant in estimating the future safety performance of existing facilities
  - When traffic conditions change significantly
  - When projects make substantial design changes to those facilities.
- May be of limited or no relevance for project alternatives that substantially change the type of the roadway or for facilities on brand new locations.
- There is a need, therefore, to select the appropriate safety assessment method or methods for the unique project development task.

# Safety Assessment Methods (Observed Data)

## Limits of Using Only Observed Crash Data

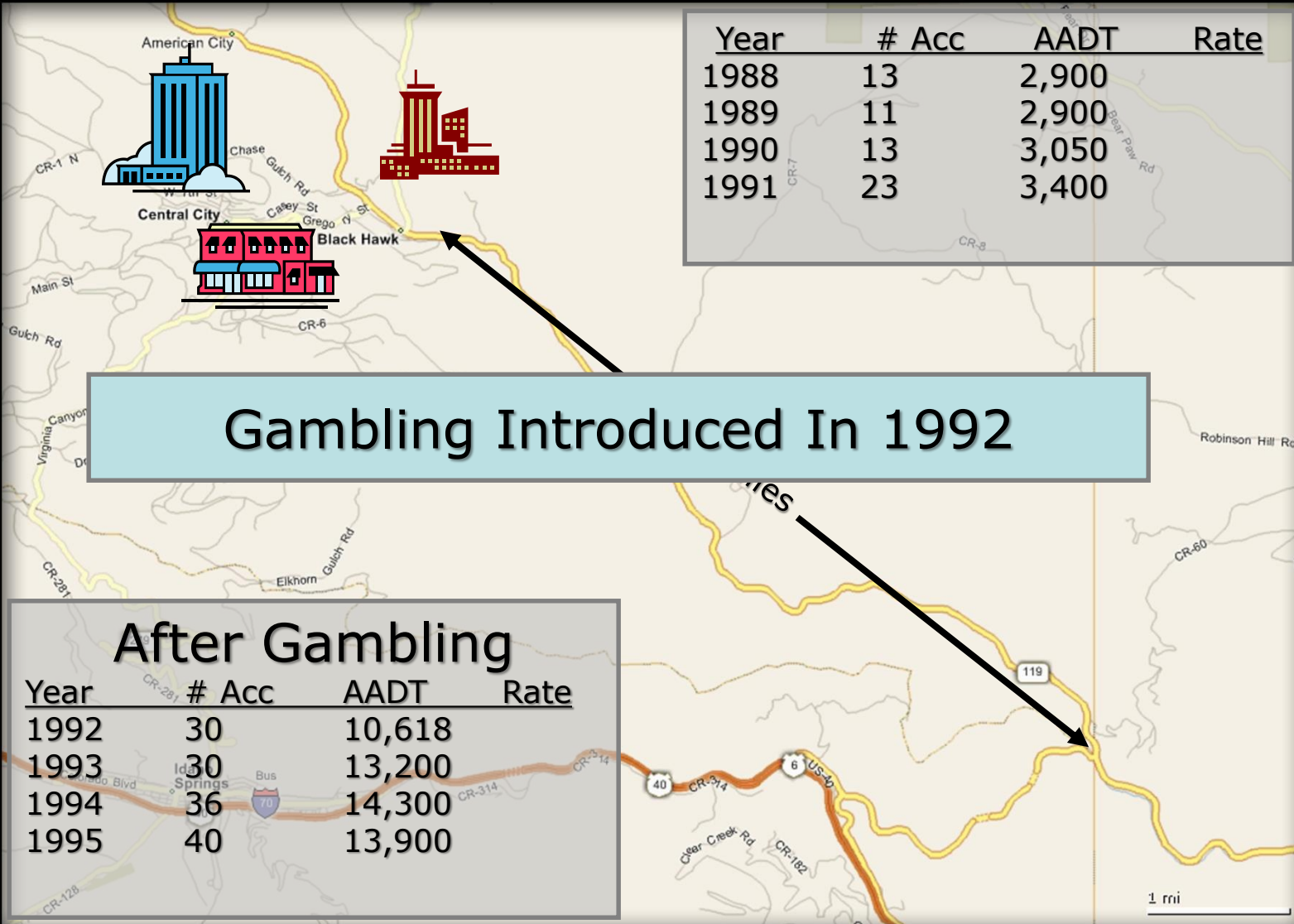
- Variability in Crash Frequency and Severity
- Isolated to only that specific location
- Regression to the Mean
- Doesn't account for changing site conditions



# So what about crash rates?

**Crash Rate is  
the Most Common  
Measure of Safety**

# The Colorado & Montana Example



## ➤ The Colorado & Montana Example

- **Before Gambling:** Average Rate = 2.26
- **After Gambling:** Average Rate = 1.23
- Highway Alignment and Typical Cross-Section have not Changed
- After the Introduction of Gambling, the % of Crashes Involving Alcohol increased 500%.

## ▶ The Colorado & Montana Example

# Is Drinking and Driving Plus Gambling Good for Highway Safety?





# How can we improve safety assessments?

Use the Highway Safety Manual

## ➤ Network Screening using the HSM

- **Safety Network Screening** is reviewing a transportation network to identify sites based on the potential for reducing average crash frequency
- A summary of Safety Network screening options are in Chapter 4 of the AASHTO's 2010 Highway Safety Manual
- Table 4-1 shows the Data and Input needs for each specific Performance Measure
- Pennsylvania uses the Excess method w/ EB adjustments

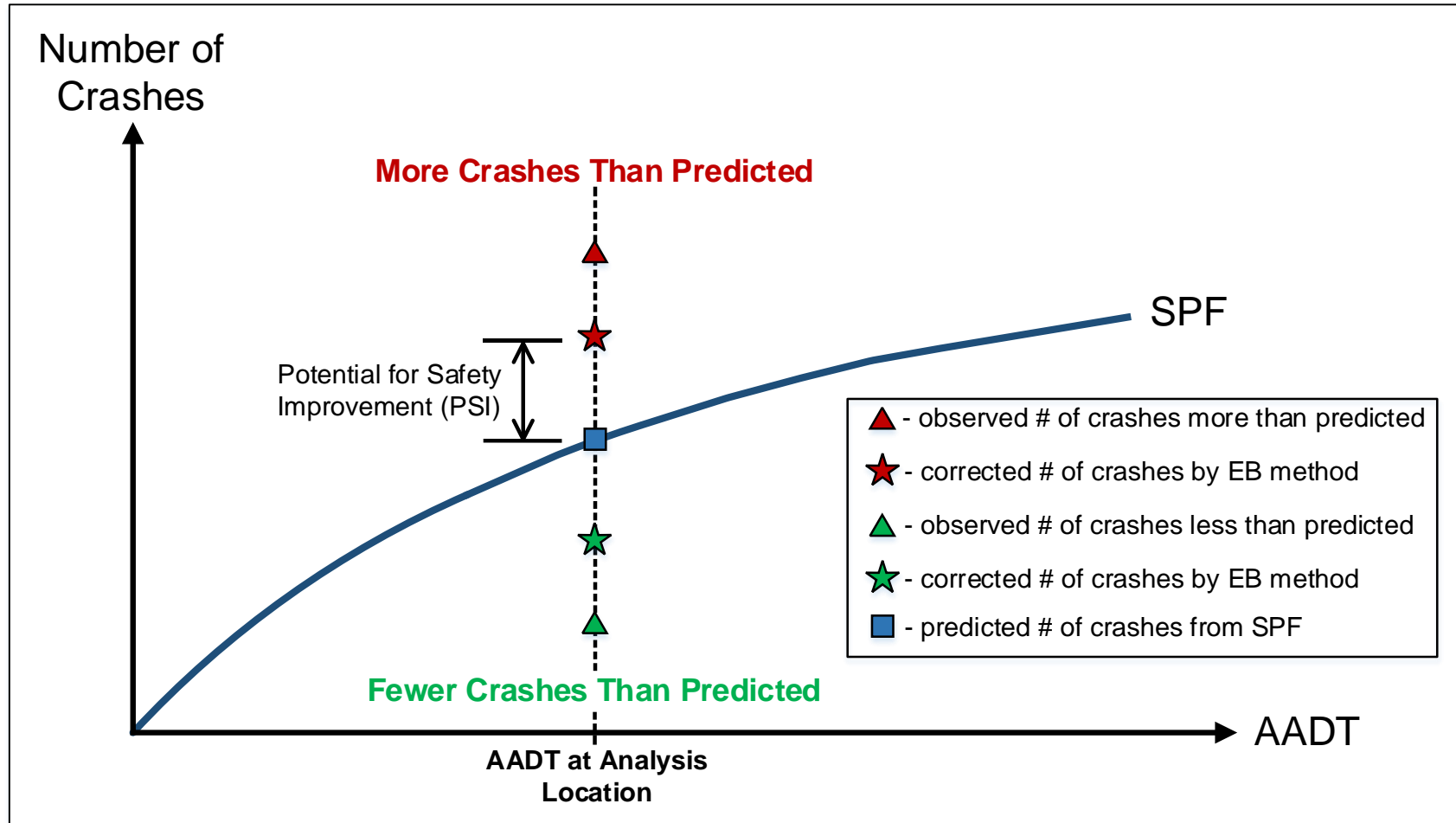
HSM2  
Removing

Performance Measure	Data Requirements			Other Inputs
	Road Type / Characteristic	Traffic Volume	Observed Crash	
Average Crash Frequency	✓		✓	
Crash Rate	✓	✓	✓	
Equivalent Property Damage Only (EPDO) Average Crash Frequency	✓		✓	EPDO Weighting Factors
Relative Severity Index	✓		✓	Relative Severity Indices
Critical Rate	✓	✓	✓	
Excess Predicted Average Crash Frequency Using Method of Moments	✓	✓	✓	
Level of Service of Safety	✓	✓	✓	Calibrated SPF with Overdispersion Parameter
Excess Predicted Average Crash Frequency Using SPFs	✓	✓	✓	Calibrated SPF
Probability of Specific Crash Types Exceeding Threshold Proportion	✓		✓	
Excess Proportion of Specific Crash Types	✓		✓	
Expected Average Crash Frequency with EB Adjustment	✓	✓	✓	Calibrated SPF with Overdispersion Parameter
EPDO Average Crash Frequency with EB Adjustment	✓	✓	✓	Calibrated SPF with Overdispersion Parameter & EPDO Weighting Factors
Excess Expected Average Crash Frequency with EB Adjustment	✓	✓	✓	Calibrated SPF with Overdispersion Parameter

PA Uses —

# Assessment Method

## HSM - Potential For Safety (Excess method w/ EB adjustment)



# ▶ Safety Analyst Tools



- Ohio
- Kansas
- Michigan
- Washington
- Illinois
- Kentucky



## Safety Analyst™

- Montana
- West Virginia
- Israel

# ➤ How To Logically Group and Compare Facilities?

## SPF Equations Developed by Penn State

- Intersections

- Two-Lane Rural
  - 5 SPF Equations based on traffic control
- Multilane Rural
  - 3 SPF Equations based on traffic control
- Urban Arterial
  - 9 SPF Equations based on District

- Segments

- Two-Lane Rural
  - 11 SPF Equations based on District
- Multilane Rural
  - 1 SPF Equation
- Two-Lane Urban / Suburban
  - 11 SPF Equations based on District
- Four-Lane Undivided Urban / Suburban
  - 1 SPF Equation
- Four-Lane Divided Urban / Suburban
  - 1 SPF Equation

# ► Pennsylvania's Highway Network Screening

## Screening Categories

- Intersections

- Urban
- Rural



- Segments

- Urban
- Rural



1. This is similar to Ohio's Network Screening categories which use Safety Analyst (only uses SPFs with AADT & no adjustments)
2. Broken down by County

## ➤ Network Screening Pilot

- Analyzed Cumberland and Erie Counties
- Utilized CDART to include:
  - Segments with crash clusters of at least 8 crashes within 1000 ft
  - Intersections with 10 or more crashes
- Utilized VideoLog and Google Maps for most site specific information
- Utilized PennDOT curve database for curve related information
- Included all dependent variable and documented all data in Excel
- Did not complete SPF calculations



## ➤ Network Screening Spreadsheet Development

- Originally envisioned utilizing PennDOT HSM Analysis Tool A to complete SPF calculations
- Developed Excel spreadsheet to enter network screening information and complete SPF / excess value calculations
  - Separate spreadsheets for intersections and segments
  - Separate tabs for rural and urban facilities
  - Separate spreadsheets for each County
  - Accounted for varying inputs based on facility type
  - Easily editable
  - Allows for additional facilities

## ➤ Network Screening – Segments

- Exclusive to State owned highways
- SPF calculations are based on AADT and dependent variables
- Utilized CDART and excluded intersection crashes
- Crash cluster thresholds varied by County from 3 and 12 crashes per 1,000 feet in order to get an average of 120 locations per County
- Those locations are split between the rural & urban tabs
- Some counties due to demographics may not have rural or urban lists or very short lists

## ➤ Network Screening – Segment Challenges

- Eliminated locations that did not fit a SPF equation
- Extended segments to eliminate partial curves
- Reconciled primary / secondary segments
- Split segments up based on critical parameters
- Additional crash data was required based on the above modifications



## ➤ Network Screening - Intersections

- Included at least one State highway
- SPF calculations are based on AADT and dependent variables
- Utilized CDART
- Crash clusters varied by County from 3 to 13 crashes per intersection in order to get an average of 160 locations per County
- Those locations are split between the rural & urban tabs
- Some counties due to demographics may not have rural or urban intersection lists or very short lists

## ➤ Network Screening – Intersection Challenges

- Eliminated locations that did not fit a SPF equation
- Needed to collect Local Road AADT for most local roads
  - 2,261 local highway counts were necessary
  - Letter from HSTOD were sent to 694 municipalities
  - Each PennDOT District was provided a list of intersections
  - Numerous emails and phone calls were received from municipalities regarding the counts
- Intersection crashes account for all crashes within a 250 foot radius. Tight intersection spacing required further analysis.



# HSM Network Screenings

[About](#)
[Content](#)
[Legend](#)

**Legend**

**Rural Safety Network Screening Intersections**

EXCESS

- > 4 - 6.2
- > 0.8 - 4
- > 0 - 0.8
- > -1.5 - 0
- 6.6 - -1.5

**Urban Safety Network Screening Intersections**

EXCESS

- > 4 - 20
- > 0.8 - 4
- > 0 - 0.8
- > -1.5 - 0
- 7.1 - -1.5

**Urban Safety Network Screening Segments**

EXCESS

- >= 4
- 0.81 to 4
- 0.01 to 0.81
- 1.5 to 0.01
- < -1.50

**Rural Safety Network Screening Segments**

EXCESS

- >= 4
- 0.81 to 4

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## ► Network Screening Limitations

1. Pennsylvania does not currently have SPF equations for various facilities such as roundabouts, ramps, ramp terminals, and freeways.
2. Pennsylvania does not have SPF equations for Fatal / Injury crashes.
3. The initial segment crash clusters are based on primary or secondary, but not both.
4. Intersection crashes account for all crashes within 250 feet.
  - Tight intersection spacing requires further analysis.
  - Intersection related crashes outside of 250 feet are not included.

# ► Network Screening Findings

Observed Crashes	Observed Crashes / Year	Predicted Crashes / Year	Overdispersion	W	Expected Crashes / Year	Excess
11	2.20	0.71	1.348	0.51	1.44	0.73
12	2.40	1.33	0.187	0.80	1.54	0.21
5	1.00	0.47	1.117	0.66	0.65	0.18
6	1.20	1.00	0.982	0.50	1.10	0.10
5	1.00	0.79	1.117	0.53	0.89	0.10
6	1.20	1.06	1.348	0.41	1.14	0.08
6	1.20	0.93	0.381	0.74	1.00	0.07
6	1.20	1.13	1.117	0.44	1.17	0.04
9	1.80	1.82	1.348	0.29	1.81	-0.01
5	1.00	1.09	1.348	0.40	1.04	-0.05
5	1.00	1.16	1.348	0.39	1.06	-0.10
6	1.20	1.38	1.117	0.39	1.27	-0.11
5	1.00	1.21	1.117	0.43	1.09	-0.12
6	1.20	1.48	1.117	0.38	1.31	-0.17
5	1.00	1.28	1.348	0.37	1.10	-0.18
9	1.80	2.23	0.381	0.54	2.03	-0.20
10	2.00	2.91	0.203	0.63	2.57	-0.34
7	1.40	1.95	1.117	0.31	1.57	-0.38
12	2.40	2.97	1.117	0.23	2.53	-0.44
7	1.40	2.37	0.381	0.53	1.91	-0.46
13	2.60	3.98	0.203	0.55	3.36	-0.62
6	1.20	2.13	1.283	0.27	1.45	-0.68
22	4.40	5.70	0.203	0.46	5.00	-0.70

## ► Network Screening Follow-Up

- Analyzed the highest excess value for each segment and intersection in each County.
- Completed a field view, detailed crash analysis, and determined potential improvement considerations.
- The top locations accounted for 19 intersection related crash trends and 11 segment related crash trends.
- Seemingly obvious issues were revealed (i.e. missing warning signage, lack of protected phasing, etc.)

## ➤ Uses/Benefits of HSM Network Screenings

- Help select HSIP project sites
- Help select LCSIP projects
- Refer to these county reports when providing design project crash analysis
  - Can be used in place of CDART Homogenous list comparison to crash rate
- Provides a fair comparison of locations based on:
  - crash data
  - facility type
  - operations data
  - geometric data
- Does not favor locations with more exposure

# ▶ PennDOT Highway Safety Manual Training

- ~~6/6/2018 — Grantville, PennDOT EPTF~~
- ~~10/10/2018 — Bridgeville, District 11-0~~
- ~~10/24/2018 — Indiana, District 10-0~~
- 2/5/2019 – King of Prussia, District 6-0
- 4/10/2019 – Grantville, PennDOT EPTF



- ❑ 1.5 Days Long
- ❑ All classes include an afternoon session dedicated to using HSM analysis tools
- ❑ Contact [RA-PDHighAdminTrain@pa.gov](mailto:RA-PDHighAdminTrain@pa.gov) to enroll

# Questions????

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